E 1.28 SOLAR/2021-79/03

Aleph 1214333

SOLAR/2021-79/03

Monthly Performance Report

IRVINE SCHOOL

MARCH 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

MONTHLY PERFORMANCE REPORT
IRVINE SCHOOL
MARCH 1979

I. SYSTEM DESCRIPTION

The El Camino Real Elementary School, referred to hereafter as Irvine School, is located in Central Orange County, California. The school is approximately ten miles from the Pacific Ocean, and was built in 1971. The building contains 41,109 square feet of floor area, and is normally occupied five days a week by 850 children and 60 adults. Building occupancy is uniform throughout the year since the school operates on a trimester plan. The solar energy system was added to the existing building, and was designed to supply 50 percent of the annual building heating and cooling demand.

The solar energy installation includes 4,950 square feet of evacuated tubular glass collectors, a heat rejector, and a heat exchanger from the collector loop to the load loop. The collector array faces south at an angle of 25 degrees from the horizontal. Water is used as the medium for delivering solar energy from the collector array to the heat exchanger for transfer to the load subsystems. Existing load loop components were unaltered except for controls. These load loop components include a 4 million Btu per hour boiler, two 100-ton absorption chillers, 41 heating coils, and seven air handlers. Since heating demands are low due to the moderate climate and most of the load demand occurs during the day, no solar energy storage is provided. The collected solar energy is transferred directly from the collector loop to the load loop via the heat exchanger. If collected energy exceeds the load loop demand, excess energy is rejected via the heat rejector. The heat rejector is a water-to-air heat exchanger mounted on the roof and situated in the collector loop between the collector outlet and the load loop heat exchanger inlet. If the solar energy does not meet the full energy demand from the loads, the boiler is activated to make up the shortage before the hot water

reaches the loads. The hot water is routed to the chillers or heating coils, or both, depending on the building demand. The hot water then returns to the heat exchanger to complete the cycle.

The system, shown schematically in Figure 1, has five modes of solar operation.

Mode 1 - Collector Protection: This mode occurs when the lower flow capacity (15 GPM) auxiliary collector pumps are turned on by a clock timer. This is normally before collection begins and is required to precondition the collectors for main pump flow and ambient temperature conditions. This mode is reentered daily at the completion of mode 2 operation, and is subsequently terminated by the clock timer. Since no other freeze protection subsystem is provided, this mode is also entered when the outside ambient temperature is less than 38°F. The clock controller is overridden for freeze protection entry when this control temperature has been reached.

Mode 2 - Solar Energy Collection: This mode occurs when the main collector pump (125 GPM) is on. Mode entry requires a differential temperature of 15°F between the collector outlet and the load side inlet to the heat exchanger. When the differential temperature again drops below 15°F (adjustable), mode 1 is reentered.

Mode 3 - Collector-to-Space Heating/Cooling: In this mode, heating and cooling loads may be active at the same time. This mode is enabled at all times, and receives energy from the solar energy system when available. If solar energy is not available, or is insufficient to satisfy the full demand, the auxiliary boiler is activated to supply the remaining demand. At night, this mode is normally disabled by the clock timer.

Mode 4 - Solar Heat Rejection: This mode occurs when excess solar energy is diverted from the collector loop and rejected to the environment

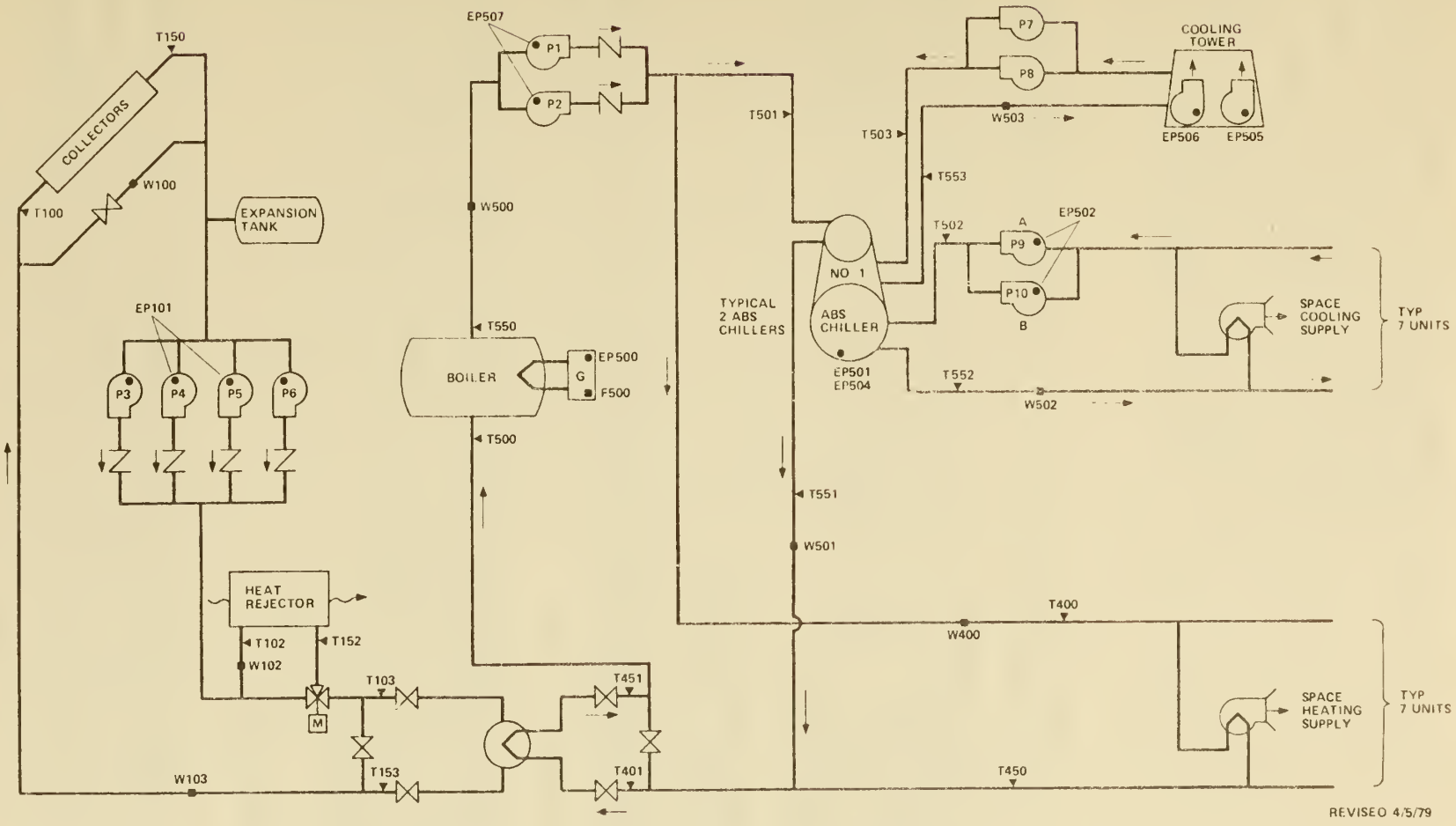

Figure 1. IRVINE SCHOOL SOLAR ENERGY SYSTEM SCHEMATIC

through a liquid-to-air heat exchanger on the roof. This mode is entered if the temperature at the collector loop outlet from the heat exchanger exceeds a variable set point (approximately 215°F). Upon exceeding this set point temperature, a three-way valve is switched to initiate collector loop flow through the heat rejector, and the heat rejector fan is turned on to increase the air flow across its coils. When the heat exchanger outlet temperature drops below another variable set point (approximately 200°F), the three-way valve is reversed, the heat rejector fan is turned off, and this mode is terminated.

Mode 5 - Collector Backup Protection: This mode is entered when the collector outlet temperature exceeds a set point (approximately 220°F). Control design assumes the collector pumps are not operating if this temperature is exceeded. In this mode, normally open solenoid valves allow city supply water to enter the collectors and drain out at the collector outlet. This mode protects against collector thermal shock damage if a power outage occurs.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR-76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The solar energy system at Irvine School operated continuously during March, and satisfied 23 percent of the combined space heating and cooling energy requirements. By design, the system performed heating and cooling simultaneously for different areas of the building. The space cooling requirements were 63 percent of the total system load.

B. Weather

Due to the year-round mild outside ambient temperatures in the Irvine School area, only a relatively small heating load, or cooling load, is expected. In comparison to an expected outside ambient temperature of 55°F, the actual outside ambient temperature averaged 59°F during the month. The measured insolation in the plane of the collectors averaged 1,651 Btu/ft^2-day, which is below the expected long-term average of 1,972 Btu/ft^2-day which was derived from measurements taken at the Los Angeles International Airport, California.

C. System Thermal Performance

Collector - Of the 253.28 million Btu of solar energy incident on the collector array during March, 245.15 million Btu were incident on the collector array when there was fluid circulating in the collector loop. The system collected 102.76 million Btu of solar energy, or 41 percent of the total incident insolation on the collector array. In this solar energy system, collected energy is either rejected through the heat rejector or delivered to the load. No storage of energy is provided. During March, 19.50 million Btu of energy were rejected by the heat rejector in the collector-to-load loop, resulting in a net collection of 83.26 million Btu of energy.

Space Heating - The outside ambient temperatures during March were low enough to require heating of the building almost every day. The resulting heating load was 39.66 million Btu. The heating subsystem utilized 5.13 million Btu of solar energy, and 42.40 million Btu of auxiliary energy. The resulting solar fraction for space heating is 13 percent. The operating expense of the space heating subsystem was 4.29 million Btu.

Space Cooling - The space cooling subsystem was used every day in the month of March. The space cooling load was 68.40 million Btu. There were 72.71 million Btu of solar energy used, and 219.40 million Btu of auxiliary energy used for space cooling. The sum of the solar and auxiliary energies

used was 292.11 million Btu, which supported the space cooling load through the absorption chillers. The resulting solar fraction for space cooling is 29 percent, and the operating energy of the space cooling subsystem during March was 79.20 million Btu.

D. Observations

During March, 23.94 million Btu of auxiliary energy were delivered to the collector array. This occurred early in the mornings, usually prior to sunrise when the collector pumps were initially turned on, and there was either a heating or cooling load, thus, providing flow through the load-side of the heat exchanger. A calculated value of 3.57 million Btu of energy was collected when no insolation was available. This phenomenon is believed to be caused by the ability of the collector tubes to maintain relatively high fluid temperatures overnight, thereby maintaining a positive temperature change across the collector array; the collector pumps are initially turned on between 4:00 and 4:30 a.m. each day.

The calculated value of energy extracted from the boiler load-side of the collector-to-load heat exchanger was 88.00 million Btu. This value is six percent higher than the net solar energy collected. This energy imbalance is believed to be due to uncertainties in temperature measurement, and the fact that some of the auxiliary energy delivered to the collectors is returned as useful energy. The average flowrate through the heat exchanger in the collector-to-boiler loop is relatively large at approximately 4,998 lbs/min. Therefore, an energy imbalance can be observed due to a small uncertainty in the temperature measurements T401 or T451. For example, an 0.5 degree uncertainty in the temperature difference (T451-T401) can result in an 8 million Btu error in the energy extracted from the heat exchanger during the month. Therefore, any attempt to resolve energy imbalances between energy collected, energy extracted from the heat exchanger, and the energy delivered to the load will be quite difficult, since each temperature sensor has a rate accuracy of 0.25°F. In an attempt to only recognize valid measurements from the instrumentation, noise level

checks are performed on the output of the sensors. These checks are intended to reject sensor noise and select only valid sensor data. However, in an attempt not to set the constants used in the noise level test too high, so as to reject valid data, occasionally a measurement will appear acceptable even though it is only noise. These anomalies have very little impact on the monthly performance factors since they generally occur only in a few scans of data during the month.

Irvine School is a large building with few windows. It contains 41,109 square feet of floor area, and is normally occupied by 910 people. Considering the climate of Orange County, buildings of this type generally require heating and cooling during winter months. The heating and cooling system at Irvine School is designed to operate simultaneously when necessary. There are seven separate zones in the building which are heated or cooled. The current instrumentation philosophy does not permit thermal analysis of each zone separately. Therefore, the data in the space heating and space cooling subsections of the attached report refers to the combined cooling or combined heating requirements for the entire school.

Similarly, the inside ambient air temperature defined in the space heating and space cooling subsections of the attached report does not reflect the average temperature for all zones, but represents the average inside ambient air temperature in the area of the sensor.

The average daily values of the Coefficient of Performance (COP) for the absorption chillers range from a low of 0.06 to 0.41. These values can be misleading because frequently with absorption chillers operating, the temperature drops across the cooling coils is less than one degree. The air-handling units are uninstrumented, therefore, it has not been possible to determine if the fans are on when W502 indicates flows and the temperature change between T552 and T502 is very small. With small temperature changes, the instrumentation uncertainties can make the calculated value of cooling load unreliable, and hence an unreliable COP.

An estimated value was used for power consumption of the pumps in the cooling tower loop, since these pumps are uninstrumented.

E. Energy Savings

The Irvine School solar energy system resulted in a fossil fuel savings of 129.73 million Btu at an operating expense of 10.82 million Btu of electrical energy. Converting the electrical energy to a fossil equivalent yields 36.07 million Btu of operating energy. Therefore, the net fossil savings was 93.66 million Btu. The fossil energy savings calculations are based on a comparison of the projected energy requirements of a conventional, fossil energy boiler, with an efficiency of 60 percent, and the energy requirements of the solar energy system.

III. ACTION STATUS

The Coefficient of Performance of the absorption chillers seems unreasonably low, and investigations are continuing to determine whether this is due to system operation or some instrumentation anomaly.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/03
REPORT PERIOD: MARCH,1979

SITE/SYSTEM DESCRIPTION:
THE SOLAR ENERGY SYSTEM WILL AUGMENT THE EXISTING HEATING AND COOLING SYSTEM BY PROVIDING HEATED WATER FOR ABSORPTION CHILLERS AND BUILDING HEAT. SOLAR ENERGY IS COLLECTED BY BANKS OF EVACUATED GLASS TUBE COLLECTORS AND TRANSFERRED TO THE LOADS VIA A HEAT EXCHANGER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	253.285	MILLION BTU
	5116*	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	102.759	MILLION BTU
	2075*	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	59	DEGREES F
AVERAGE BUILDING TEMPERATURE	73	DEGREES F
FOSS SOLAR CONVERSION EFFICIENCY	0.31	
FOSS OPERATING ENERGY	10.821	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	94.316	MILLION BTU
TOTAL ENERGY CONSUMED	538.440	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	N.A.	39.661	68.399	108.060	MILLION BTU
SOLAR FRACTION	N.A.	13	29	23	PERCENT
SOLAR ENERGY USED	N.A.	5.129	72.711	77.840	MILLION BTU
OPERATING ENERGY	N.A.	4.290	79.204	94.316	MILLION BTU
AUX. THERMAL ENERGY	N.A.	42.403	219.403	275.587	MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A.	MILLION BTU
AUX. FOSSIL FUEL	N.A.	61.279	279.436	342.787	MILLION BTU
ELECTRICAL SAVINGS	N.A.	N.A.	0.000	-10.821	MILLION BTU
FOSSIL SAVINGS	N.A.	8.549	121.184	129.734	MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.165

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/03
REPORT PERIOD: MARCH,1979

SITE/SYSTEM DESCRIPTION:
THE SOLAR ENERGY SYSTEM WILL AUGMENT THE EXISTING HEATING AND COOLING SYSTEM BY PROVIDING HEATED WATER FOR ABSORPTION CHILLERS AND BUILDING HEAT. SOLAR ENERGY IS COLLECTED BY BANKS OF EVACUATED GLASS TUBE COLLECTORS AND TRANSFERRED TO THE LOADS VIA A HEAT EXCHANGER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	267.215 GIGA JOULES
	581070 KJ/SQ.M.
COLLECTED SOLAR ENERGY	108.411 GIGA JOULES
	235744 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	15 DEGREES C
AVERAGE BUILDING TEMPERATURE	23 DEGREES C
FCSS SOLAR CONVERSION EFFICIENCY	0.31
FCSS OPERATING ENERGY	11.417 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	99.503 GIGA JOULES
TOTAL ENERGY CONSUMED	568.054 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	41.842	72.161	114.003 GIGA JOULES
SOLAR FRACTION	N.A.	13	29	23 PERCENT
SOLAR ENERGY USED	N.A.	5.412	76.710	82.121 GIGA JOULES
OPERATING ENERGY	N.A.	4.526	83.560	99.503 GIGA JOULES
AUX. THERMAL ENG	N.A.	44.735	231.470	290.744 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
AUX. FOSSIL FUEL	N.A.	64.649	294.805	361.640 GIGA JOULES
ELECTRICAL SAVINGS	N.A.	N.A.	0.000	-11.417 GIGA JOULES
FOSSIL SAVINGS	N.A.	9.019	127.850	136.869 GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.165

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978. SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/03
REPORT PERIOD: MARCH, 1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	2.878	52	2.242	0.972	0.302	0.000	0.593
2	10.365	52	4.272	0.173	0.303	0.000	0.338
3	10.330	55	0.000	0.000	0.319	2.293	0.000
4	9.862	58	3.900	0.320	0.354	0.000	0.369
5	10.259	67	4.394	0.572	0.359	0.000	0.398
6	11.261	73	4.838	0.287	0.369	0.000	0.394
7	10.638	69	5.164	0.685	0.371	0.000	0.442
8	9.042	60	4.121	0.999	0.357	0.000	0.418
9	6.599	62	2.976	0.472	0.341	0.000	0.378
10	9.673	62	0.000	0.000	0.327	1.883	0.000
11	9.983	62	4.404	0.585	0.367	0.000	0.417
12	9.804	62	4.477	0.700	0.374	0.000	0.418
13	4.523	59	2.106	0.675	0.365	0.000	0.383
14	7.147	61	3.270	0.676	0.373	0.000	0.398
15	6.700	58	3.548	1.830	0.367	0.411	0.425
16	9.915	57	4.274	0.825	0.365	0.000	0.389
17	9.127	55	0.000	0.000	0.316	1.270	0.000
18	6.993	56	2.901	0.731	0.367	0.000	0.349
19	6.458	52	2.815	1.447	0.368	0.000	0.397
20	4.452	53	1.769	1.111	0.368	0.172	0.372
21	3.081	54	1.166	0.791	0.372	0.000	0.250
22	9.822	58	4.278	0.752	0.369	0.000	0.382
23	10.454	58	4.441	0.583	0.368	0.000	0.390
24	11.128	61	0.000	0.000	0.329	2.752	0.000
25	10.712	61	0.172	2.093	0.339	5.448	0.015
26	7.353	61	3.856	1.389	0.404	0.000	0.446
27	1.311	56	0.857	1.486	0.361	0.000	0.509
28	6.224	57	3.438	2.250	0.321	2.039	0.536
29	7.018	56	4.544	1.163	0.292	0.985	0.556
30	8.763	57	3.777	0.378	0.330	0.000	0.382
31	11.409	60	0.000	0.000	0.304	2.245	0.000
SUM	253.285	-	88.003	23.944	10.821	19.497	-
AVG	8.170	59	2.839	0.772	0.349	0.629	0.307
NBS ID	0001	N113			0102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/03
REPORT PERIOD: MARCH,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	2.878	2.878	1.705	55	0.593
2	10.365	9.099	3.614	64	0.349
3	10.330	9.634	2.900	69	0.280
4	9.862	9.673	3.991	74	0.405
5	10.259	10.081	4.602	83	0.449
6	11.261	10.970	4.554	88	0.404
7	10.638	10.576	4.830	86	0.454
8	9.042	9.016	3.917	74	0.433
9	6.599	6.507	2.615	72	0.396
10	9.673	9.277	2.724	74	0.282
11	9.983	9.914	4.271	75	0.428
12	9.804	9.716	4.285	75	0.437
13	4.523	4.514	1.891	64	0.418
14	7.147	7.065	2.993	70	0.419
15	6.799	6.780	3.053	67	0.449
16	9.815	9.743	4.120	65	0.420
17	9.127	8.445	2.502	61	0.274
18	6.993	6.947	2.572	64	0.368
19	6.459	6.458	2.927	56	0.453
20	4.452	4.397	2.043	58	0.459
21	3.081	3.067	0.906	59	0.294
22	9.822	9.631	3.832	71	0.390
23	10.454	10.311	4.422	72	0.423
24	11.128	10.640	3.483	73	0.313
25	10.712	10.496	4.527	71	0.423
26	7.353	7.353	3.344	70	0.455
27	1.311	1.311	0.905	59	0.690
28	6.224	5.635	3.807	58	0.626
29	7.018	6.424	4.379	63	0.624
30	8.763	7.974	3.585	67	0.409
31	11.409	10.625	3.782	74	0.296
SUM	253.285	245.154	102.759	-	-
AVG	8.170	7.908	3.315	69	0.406
NRSID	0001		0100		N100

* DENOTES UNAVAILABLE DATA.
- DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SCLAR/2021-79/03
REPORT PERIOD: MARCH,1979

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	1.594	6	0.092	0.132	1.912	N	2.817	N	0.153	71	52
2	2.032	10	0.206	0.160	2.107	O	2.466	O	0.342	70	52
3	0.000	0	0.000	0.000	0.000	T	0.000	T	0.000	68	55
4	2.727	11	0.284	0.159	2.489		3.582		0.473	70	58
5	1.740	12	0.210	0.131	1.893	A	2.787	A	0.350	73	67
6	0.423	12	0.050	0.052	0.478	P	0.712	P	0.083	77	73
7	0.000	0	0.000	0.000	0.000	P	0.000	P	0.000	76	69
8	0.807	15	0.117	0.048	0.642	L	1.049	L	0.196	75	60
9	0.956	9	0.088	0.057	0.942	I	1.255	I	0.147	76	62
10	0.000	0	0.000	0.000	0.000	C	0.000	C	0.000	74	62
11	1.953	13	0.259	0.120	1.735	A	2.570	A	0.431	73	62
12	1.701	9	0.155	0.099	1.581	B	2.320	B	0.259	74	62
13	0.970	7	0.068	0.060	1.021	L	1.396	L	0.113	75	59
14	1.186	14	0.167	0.089	1.144	E	1.610	E	0.278	75	61
15	1.384	12	0.157	0.102	1.642		2.052		0.261	74	58
16	1.933	23	0.424	0.239	1.684		2.331		0.706	74	57
17	0.000	0	0.000	0.000	0.000		0.000		0.000	71	55
18	2.626	18	0.571	0.419	2.632		4.521		0.952	71	56
19	1.867	14	0.272	0.264	2.167		4.413		0.454	72	52
20	1.716	12	0.212	0.241	1.856		2.435		0.353	73	53
21	1.755	5	0.098	0.265	2.195		1.758		0.164	73	54
22	1.520	16	0.267	0.182	1.808		2.814		0.445	74	58
23	1.668	15	0.257	0.206	1.923		3.047		0.429	74	58
24	0.000	0	0.000	0.000	0.000		0.000		0.000	72	61
25	1.936	1	0.034	0.191	2.378		2.626		0.056	73	61
26	1.527	20	0.335	0.203	1.260		2.538		0.558	73	61
27	1.194	3	0.053	0.187	1.810		2.898		0.089	73	56
28	1.728	21	0.309	0.217	1.748		0.024		0.515	73	57
29	1.215	21	0.234	0.178	1.540		2.872		0.389	73	56
30	1.506	14	0.213	0.200	1.816		2.385		0.354	74	57
31	0.000	0	0.000	0.000	0.000		0.000		0.000	72	60
SUM	39.661	-	5.129	4.290	42.403	N.A.	61.279	N.A.	8.549	-	-
AVG	1.279	13	0.165	0.138	1.368	N.A.	1.977	N.A.	0.276	73	59
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE COOLING SUBSYSTEM

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/03
REPORT PERIOD: MARCH,1979

DAY OF MON.	SPACE COOLING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG DRY BULB TEMP F	AMB TEMP DEG F
1	1.122	16	1.614	2.720	11.621	N	14.942	0.000	2.689	71	52
2	1.406	20	3.294	2.725	12.189	O	12.517	0.000	5.490	70	52
3	0.432	0	0.000	1.719	0.000	T	0.000	0.000	0.000	68	55
4	0.972	22	3.758	2.723	10.696		14.704	0.000	5.597	70	58
5	4.511	36	3.874	2.890	8.753	A	11.519	0.000	6.457	73	67
6	5.578	33	4.382	3.218	9.872	P	12.550	0.000	7.303	77	73
7	5.393	26	4.707	3.305	15.840	P	21.447	0.000	7.845	76	69
8	3.741	26	3.658	3.107	14.426	L	20.039	0.000	6.057	75	60
9	3.663	16	2.405	3.019	16.338	I	20.941	0.000	4.009	76	62
10	0.417	0	0.000	1.801	0.000	C	0.000	0.000	0.000	74	62
11	1.619	30	3.906	2.842	10.282	A	14.260	0.000	6.510	73	62
12	3.876	25	3.944	3.045	13.991	B	17.080	0.000	6.573	74	62
13	2.984	10	1.667	2.981	16.350	L	22.044	0.000	2.778	75	59
14	3.167	27	2.675	2.843	10.074	E	12.961	0.000	4.458	75	61
15	2.731	26	2.735	2.660	5.551		7.989	0.000	4.555	74	58
16	2.627	44	3.394	2.606	4.567		5.911	0.000	5.657	74	57
17	0.412	0	0.000	1.802	0.000		0.000	0.000	0.000	71	55
18	0.774	41	1.868	2.371	2.071		3.098	0.000	3.113	71	56
19	1.422	45	2.288	2.555	3.167		5.249	0.000	3.814	72	52
20	1.632	25	1.445	2.572	3.983		6.904	0.000	2.408	73	53
21	1.703	13	0.673	2.553	5.322		4.780	0.000	1.122	73	54
22	2.901	42	3.486	2.666	5.474		7.257	0.000	5.810	74	58
23	3.100	33	3.821	2.634	8.072		10.035	0.000	6.368	74	58
24	0.499	0	0.000	1.769	0.000		0.000	0.000	0.000	72	61
25	1.030	2	0.129	2.197	5.993		5.376	0.000	0.215	73	61
26	2.000	39	2.942	2.469	4.693		6.495	0.000	4.904	73	61
27	1.651	0	0.614	2.453	6.953		7.266	0.000	1.024	73	56
28	1.853	54	3.027	2.425	3.975		0.084	0.000	5.046	72	57
29	1.897	73	3.671	2.486	2.900		5.308	0.000	6.118	73	56
30	2.830	35	3.134	2.470	6.251		8.679	0.000	5.223	74	57
31	0.497	0	0.000	1.579	0.000		0.000	0.000	0.000	72	60
SUM	68.399	-	72.711	79.204	219.403	N.A.	279.436	0.000	121.184	-	-
AVG	2.206	29	2.346	2.555	7.077	N.A.	9.014	0.000	3.909	73	59
NBS	Q502	N500	Q500	Q503	Q501		Q508	Q512	Q514	N406	N113

* DENOTES UNAVAILABLE DATA.
0 DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/03
REPORT PERIOD: MARCH,1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	581	439	52	55	N	N	N
2	2004	727	52	64	O	O	O
3	2087	727	55	69	T	T	T
4	1902	714	58	74			
5	2073	708	67	83	A	A	A
6	2275	666	73	88	P	P	P
7	2140	576	69	86	P	P	P
8	1827	539	60	74	L	L	L
9	1333	696	62	72	I	I	I
10	1954	854	62	74	C	C	C
11	2017	847	62	75	A	A	A
12	1981	797	62	75	P	P	P
13	914	729	59	64	L	L	L
14	1444	875	61	70	E	E	E
15	1374	795	58	67			
16	1983	648	57	65			
17	1844	747	55	61			
18	1413	707	56	64			
19	1305	902	52	56			
20	899	552	53	58			
21	623	551	54	59			
22	1984	877	58	71			
23	2112	708	58	72			
24	2248	600	61	73			
25	2164	630	61	71			
26	1485	919	61	70			
27	265	239	56	59			
28	1257	747	57	58			
29	1418	835	56	67			
30	1770	852	57	67			
31	2305	566	60	74			
SUM	51169	21760	-	-	-	-	-
AVG	1651	702	59	69	N.A.	N.A.	N.A.
NBS ID	0001		N113			N115	N114

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
THERMODYNAMIC CONVERSION EQUIPMENT

SITE: IRVINE SCHOOL IRVINE CALIFORNIA SOLAR/2021-79/03
REPORT PERIOD: MARCH,1979

DAY OF MONTH	EQUIPMENT LOAD MILLION BTU	THERMAL ENERGY INPUT MILLION BTU	OPERATING ENERGY MILLION BTU	ENERGY REJECTED MILLION BTU	COEFFICIENT OF PERFORMANCE (SEE NOTE)
1	1.122	12.270	1.764	10.134	0.091
2	1.406	14.746	1.789	12.540	0.095
3	0.432	0.000	1.719	0.375	0.000
4	0.932	14.624	1.793	11.336	0.064
5	4.511	12.028	1.930	13.381	0.375
6	5.578	13.649	2.156	14.819	0.409
7	5.393	20.725	2.227	23.217	0.260
8	3.741	17.817	2.071	20.055	0.210
9	3.663	17.897	1.993	19.100	0.205
10	0.417	0.000	1.801	0.281	0.000
11	1.619	14.170	1.871	11.875	0.114
12	3.876	18.020	2.059	19.476	0.215
13	2.984	17.214	1.955	17.882	0.173
14	3.167	11.979	1.840	13.471	0.264
15	2.731	7.997	1.760	10.088	0.342
16	2.627	8.045	1.753	9.448	0.326
17	0.412	0.000	1.802	0.326	0.000
18	0.774	3.241	1.697	1.985	0.239
19	1.422	5.175	1.730	4.877	0.275
20	1.632	5.024	1.725	5.046	0.325
21	1.703	5.059	1.726	5.541	0.337
22	2.901	8.223	1.758	10.125	0.353
23	3.100	11.343	1.754	14.328	0.273
24	0.499	0.000	1.769	0.343	0.000
25	1.030	5.740	1.780	5.721	0.180
26	2.000	7.132	1.579	7.511	0.280
27	1.651	5.714	1.549	5.875	0.289
28	1.853	7.297	1.555	7.625	0.254
29	1.997	5.772	1.569	6.285	0.329
30	2.830	9.194	1.576	10.772	0.308
31	0.497	0.000	1.579	0.383	0.000
SUM	68.799	280.085	55.628	294.219	0.244
AVG	2.206	9.035	1.794	9.491	0.008

* DENOTES UNAVAILABLE DATA.
Ø DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.
NOTE:

UNIVERSITY OF FLORIDA
3 1262 09052 5519